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ABSTRACT

When Sonoma State Hospital, a large residential center for developmentally disabled persons in California, needed to condense nine of its treatment programs to six to meet licensing requirements and adapt to a reduction in population, a committee decided to reorganize according to data in the form of ratings on 66 performance scales from the annually completed Client Development Evaluation Report. The scores of a stratified random sample of developmentally disabled persons throughout the state were cluster analyzed, and programs developed from these data. Ten dimensions of developmental functioning emerged, and six were chosen to develop a client typology. Typological analysis resulted in 13 highly homogeneous groups. The data were further refined for the development of six new treatment program definitions. (Author)

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Cluster Analysis as a Basis for Treatment Program Reorganization

Necessitated by remodeling of residences to meet licensing requirements, consequent reduction in population by 500 and a proportional number of staff members, Sonoma State Hospital, a large residential facility for the developmentally disabled, had to condense nine of its treatment programs to six. Hospital administration appointed a committee to recommend new programs and required that the reorganization result in clearly defined, homogeneous groupings of residents.

Method

After studying alternatives, the committee decided to place program reorganization on a base which was objective and empirical rather than one which was preconceived or theoretical. For example, assumptions as to the importance of age, body size, and ambulatory ability were discarded.

Data previously existed on each hospital resident in the form of ratings on 66 performance scales from the annually completed Client Development Evaluation Report (CDER), an instrument developed by the California Department of Developmental Services (1978).

The scores of a stratified random sample of developmentally disabled persons throughout the state were cluster analyzed by the BC TRY computer system (Tryon and Bailey, 1970) and programs were developed from these data.

Results

Ten dimensions of developmental functioning emerged. Six were chosen for the purpose of developing a client typology. Typological analysis resulted in 13 highly homogeneous groups. The data were further refined for the development of six new treatment program definitions.

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Discussion

The six empirical program groupings were judged by hospital administration to be understandable, clearly defined and of sufficient homogeneity to serve as the basis for treatment of developmentally disabled persons. Because the CDER and the resulting clusters provided data on developmental functioning and not priority needs and because evaluation and determination of needs and services was the responsibility of the client's interdisciplinary team, the team itself made the determination of most appropriate placement into new programs using the cluster analysis data and new program definitions.

CLUSTER ANALYSIS AS A BASIS FOR TREATMENT PROGRAM REORGANIZATION

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INTRODUCTION

In 1979, Sonoma State Hospital & Developmental Center, which is a residential facility for the developmentally disabled, was faced with the beginning of a 3-1/2 year living unit renovation project to continue to meet State and Federal certification requirements. The project required a population reduction from 1850 to 1400 residents. The Sonoma Administration decided that along with the renovation and the consequent reduction in population, its residential programs should be reorganized.

I will be presenting to you a process for reorganizing these programs which hopefully would be useful for anyone with a similar task.

At the time, we had 12 residential treatment programs which were developed in 1972 (SLIDE 1). Over the years, these programs came to lose their distinctiveness so that each contained some residents who, at different times, different staff considered to be misplaced.

(Slide 1 here)

The present paper primarily concerns reorganization of the first nine programs into six new ones.

After considerable deliberation, the committee assigned to the project adopted seven criteria for the development of new programs. The new programs would (SLIDE 2):

(Slide 2 here)

METHOD AND RESULTS

CDER. The only database commonly existing for all residents was in the form of scores on 66 rating scale items in an instrument called the Client Development Evaluation Report or CDER (1978). It was developed over a three year period by the California State Department of Developmental Services for assessing all the developmentally disabled under its auspices. The CDER asks questions about client functioning in motor, independent living, social, emotional, cognitive and communication areas. An unpublished 1978 study of data from 89 clients indicated that the average inter-rater reliability for the 66 items was .87 (range = .48-1.00, avg. N = 70).

CLUSTER ANALYSIS. Tryon & Bailey's (1970) BC TRY computer system was used to factor analyze the CDER item ratings. The program yielded 10 oblique factor dimensions. These dimensions, along with their reliabilities, are presented in the next slide (SLIDE 3).

Factor	Sample Items	r*
x Mobility	Limb movements, ambulation, WC movement.	.92
x Personal Self-Sufficiency	Self help skills	.95
x Social Initiative	Interaction, participation	.88
x Self Control	Aggression, hyperactivity, smearing, resistiveness.	.84
x Community Living Skills	Money handling, food ordering.	.93
x Communication Skills	Verbal & nonverbal, receptive and expressive language.	.91
Home Care Skills		.92
Friendship Formation		.89
Adjustment		.79
Word/Number Skills		.92

*Coefficient alpha (Lord & Novick, 1968)

As can be seen, these dimensions are highly internally consistent, and the overall factor structure accounted for 98% of the commonality of the original ratings.

Six of the 10 factors were then selected for the purpose of forming a typology of clients (See "X").

These were selected because (a) their composite assessment items had relatively higher reliabilities, (b) they covered a broad range of client capabilities and (c) they were relatively less correlated with each other.

The data for the typological analysis consisted of factor scores on the six dimensions for a stratified, random, statewide sample of 655 developmentally disabled persons. The stratification variables were client age and level of mental retardation.

The results of the typological analysis were a set of 13 highly homogeneous clusters of clients (O-Types). These were (SLIDE 4):

(Slide 4 here)

The homogeneity of the O-types is quite high. The homogeneity statistic (Tryon's H; Tryon & Bailey; 1970, p. 314) indexes the degree of similarity of clients in each group. At a value of one, all clients in a group have identical dimension scores and there is no variance. We have decided, arbitrarily, that a value of .75 or better is acceptable.

One of the criteria for new programs was that age and ambulation not be used as primary selection factors. The 13 O-types ignore both of these variables.

PROGRAM CLUSTERS. Given the 13 O-types, the committee using (a) its knowledge of the residents in the then current treatment programs and (b) the O-types, and using (c) the requirements of developing new programs with the N's between 100-200, combined the O-types into six program clusters which represent

a developmental progression. However, it was found that the O-types could not be employed without modification:

(1) One of the six factors, Self-Control, could not be used because it did not well depict the seriousness nor intensity of behavior problems. This seemed to be due to the variety of assessment items in its composite.

(2) O-type 1, Profoundly Disabled, while highly homogeneous in the six factors, did not give any weight to medical problems and their prevention of developmental training programs. Consequently, an additional factor, current program placement, was used to divide this O-type. This allowed less medically involved people to be grouped into a more developmental program cluster.

Six program clusters were decided upon (SLIDES 5-10):

(Slides 5-10 here)

Each of the slides shows the profiles of the program cluster (heavy line) and the O-types, (lighter lines), which were combined to form it. In the lower right corner is the homogeneity of the program cluster profile as displayed, and, in the parentheses, the homogeneity of the program cluster without the Self-Control factor included. As you can see, the homogeneities are more acceptable without the Self-Control factor and range from .95 to .77.

The next slide (SLIDE 11), shows the six program cluster profiles in one graph. A multivariate analysis of covariance of the five factors with level of mental retardation as an obvious covariate showed that the profiles were significantly different at the .0001 probability level, both before and after level of mental retardation was partialed out. The correlation between the mental retardation and each of the five factors varied from .42 to .75. (Spearman

rhos, N = 1146, p<.0001). (Specific correlations were:

Mobility	.42
Personal Self-Sufficiency	.61
Social Initiative	.58
Self-Control	.12
Community Living Skills	.75
Communication Skills	.67)

The only means not significantly different at the .05 probability level using Duncan's Test with Kramer's adjustment for unequal groups (Kramer, 1956) were:

1) Social Initiative of E & G.

2) Community Living Skills of D, E, G, & H.

3) Communication Skills of E & G and D & E.

INTERDISCIPLINARY TEAM (IDT) PROCESS. One of the criteria established by the committee working on the reorganization project was the involvement of the interdisciplinary planning team in deciding each resident's program cluster placement. Consequently, each of the then current program IDT's received a list of their residents with each resident's statistically computed cluster designation. In written instructions, they were asked to decide the most appropriate cluster for each person based on (1) written descriptions of the program clusters (HANDOUT), (2) the groupings of their residents into cluster types, and (3) information on the number of residents in other programs which fell into the different clusters. Each IDT meeting was attended by a project committee member who explained and guided the decision making process.

The percentage of agreement between the IDT's and the statistically computed clusters is shown in the next slide (SLIDE 12).

(Slide 12 here)

There was good agreement in Medical Treatment/Physical Development (D), Physican Development (E), and Habilitation/Transition (F) clusters. There was less agreement in the Sensory-Motor Development (G), Sensory-Motor/Social Development (H) and Social Development (I) clusters. In the G and I clusters, the major portions of residents which were changed from one cluster to another were "moved up" to the next developmentally higher clusters, (17% of the 26% disagreements in G moved to H, and 20% of the 27% disagreements in I moved up to F). In the H cluster an equally large portion (19%) of residents was moved either up to I (or F) or down to G. The IDT's did not express difficulty in deciding some placements, especially between the G and H clusters.

There appeared to be two reasons why the teams disagreed with some resident's statistically computed cluster designations:

(1) They felt that some residents' assessment items were not rated accurately by their colleagues, thus leading to placement in the wrong program clusters.

(2) They used the additional variables of (a) the resident's priority need and (b) the most required type of developmental training, as well as the cluster designations, to decide the best program placement. (The fact that the cluster analysis provides descriptive data, and is not prescriptive in and of itself, was a main reason for our criteria of including the IDT in the decision making process, so we are not overly concerned about the disagreements.)

Interestingly, the final program clusters were almost as homogeneous as the statistically defined clusters (SLIDE 13).

(Slide 13 here)

As a partial test of the validity of the program clusters, one of our teachers initiated a study comparing both language and social development

scores, which were available from the Koontz Child Development Scale, with four of the clusters E, G, H, and I (SLIDE 14). The F ratios from the one-way analyses of variance were significant with a $p<.0001$. The graphs show a developmental progression from cluster to cluster.

(Slide 14 here)

CONCLUSION

As you will recall, we began this project to develop acceptable programs which would meet seven criteria (SLIDE 15):

(Slide 15 here)

The first six criteria have been clearly met.

In regard to number 6, we have begun to see some real positive experiences for higher functioning, non-ambulatory, physically disabled residents who are now living with their ambulatory, intellectually similar peers.

Word is still out on our success with Number 7 because to date the reorganization has only partially occurred. Since program clusters E, I and F have in large part been formed, their program and living unit managers were asked their opinions on our success so far. The next slide (SLIDE 16) shows their responses to the questions:

1. What percentage of your residents have been placed into groups which are similar in important characteristics?

2. For what percentage of your residents have, or will, the new groupings allow you to improve either their care, training or experiences?

(Slide 16 here)

We consider these percentages acceptable. Of the exceptions, 5-10% seemed to be related to manager's written comments that some residents do not seem to fit in well anywhere.

In conclusion, we are finding that the cluster analysis approach for establishing a typology is useful for grouping state hospital developmentally disabled persons into treatment programs. We recommend its use for this purpose if it is incorporated into a more elaborate methodology including the input of other variables to assist in decision making.

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Client Development Evaluation Report, State of California Department of Developmental Services, 1600 Ninth Street, Sacramento, CA 95814; copyrighted, 1978.

Tyron, R.C. and Bailey, D.E. Cluster analysis. New York: McGraw Hill, 1970.

Lord, F.M. and Novick, M.R. Statistical Theories of Mental Test Scores. Reading, Mass.: Addison-Wesley, 1968

Kramer, C.Y. Extension of multiple range tests to group means with unequal numbers of replication. Biometrics, 1956, 12, 307-310.

SLIDE 1

SONOMA STATE HOSPITAL & DEVELOPMENTAL CENTER
TREATMENT PROGRAMS
1972-1980

Pediatric Treatment & Development*

Physically Handicapped (Adults)*

Physical Development*

Physical & Social Dev. (Children)*

Physical & Social Dev. (Adult)*

Child Development

Social Development I

Social Development II

Habilitation

Sensory Deprived (Blind)

Communication Dev.

Behavior Adjustment

*Non-Ambulatory

SLIDE 2

CRITERIA FOR NEW PROGRAMS

New programs should:

1. Have more compa·able residents than do current programs.
2. Not be defined with age or ambulation factors.
3. Number approximately nine.
4. Be based empirically rather than on pre-conceived notions.
5. Be derived from data available on all residents.
6. Be partially derived from ID Team decision.
7. Each consist of a projected 100-200 residents.

SLIDE 3

CDER FACTORS

FACTOR	RELIABILITY*
X Mobility	.92
X Personal Self Sufficiency	.95
X Social Initiative	.88
X Self Control	.84
X Community Living	.93
X Communication Skills	.91
Home Care Skills	.92
Friendship Formation	.89
Adjustment to Change	.79
Word/Number Skills	.92

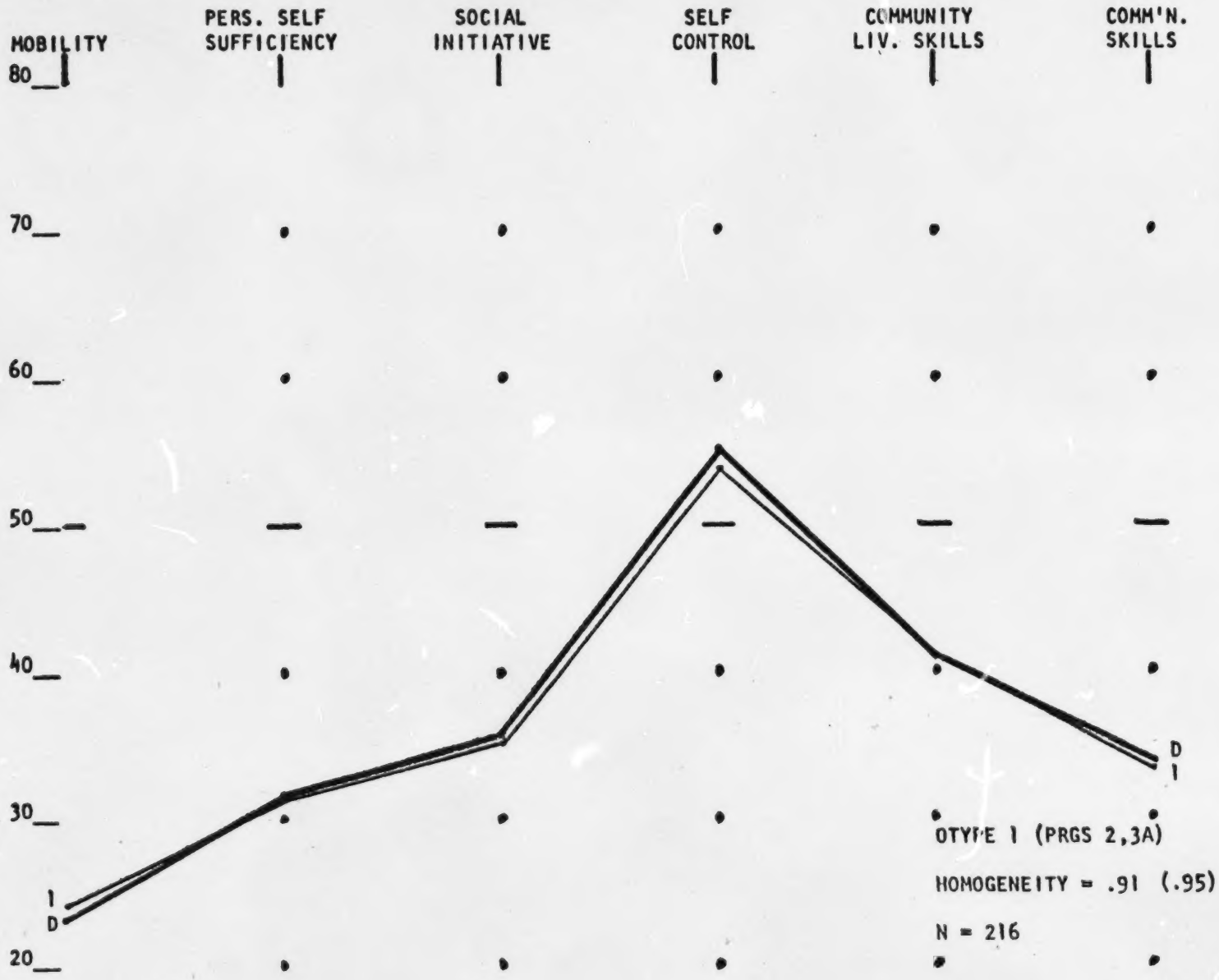
*Co-efficient alpha

SLIDE 4

CLUSTER ANALYSIS OTYPES
SONOMA DATA

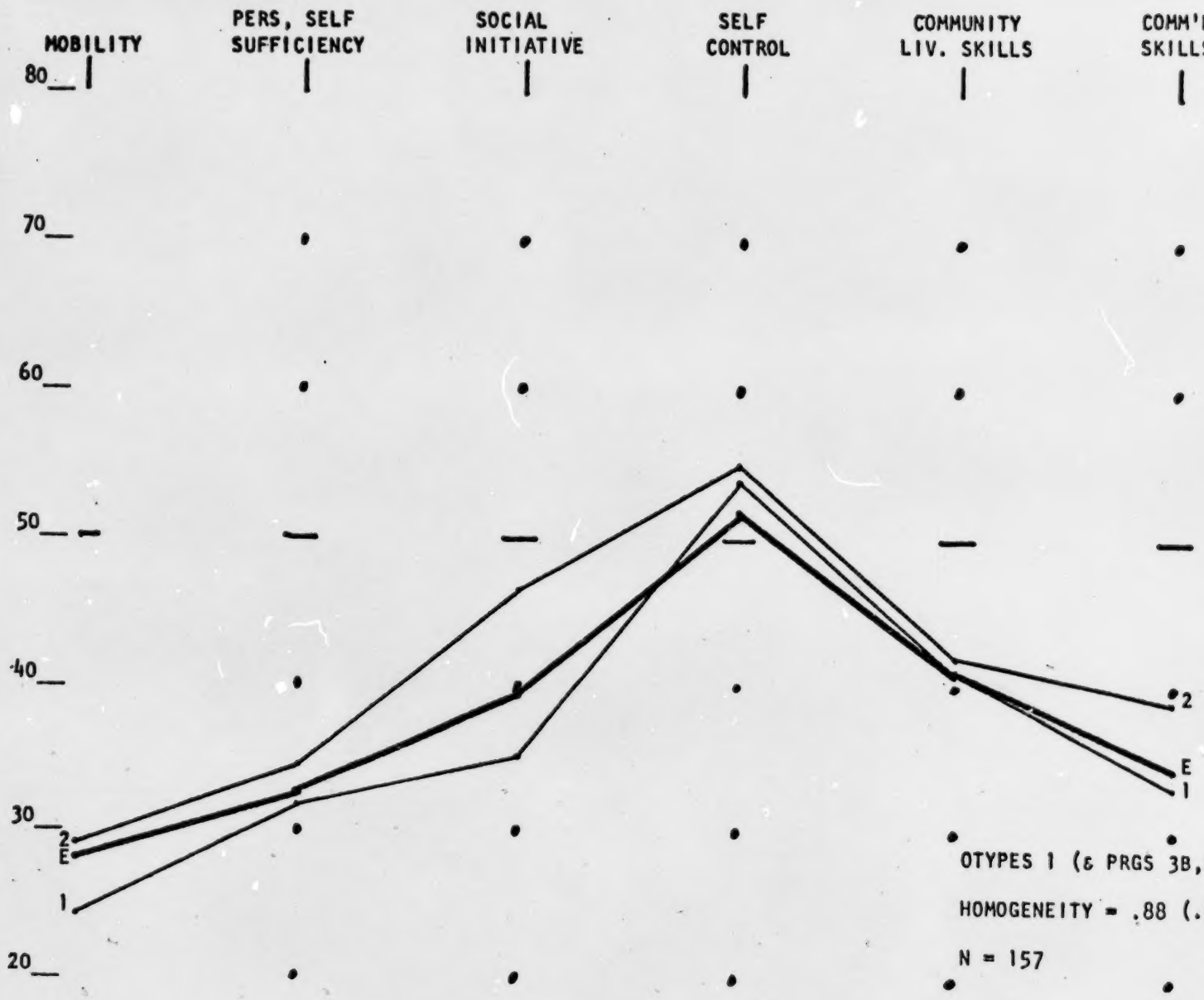
O-TYPE	HOMOGENEITY	N
1. Profoundly Disabled	.93	320
2. Profoundly Disabled/Social	.89	92
3. Physically Disabled/High Functioning	.82	42
4. High Care/Behavior Problems	.92	167
5. High Care	.91	101
6. High Care/Severe Behavior Problem	.92	99
7. High Care/Non-verbal	.90	97
8. High Care/Self Controlled	.85	37
9. Behavior Problems/Withdrawn	.90	179
10. Socially Withdrawn	.90	109
11. Behavior Problem	.87	130
12. Moderate Care	.91	100
13. Low Care	.90	64
OVERALL	.90	1537

MEDICAL TREATMENT/PHYSICAL DEVELOPMENT (D)



SLIDE 5

PHYSICAL DEVELOPMENT (E)



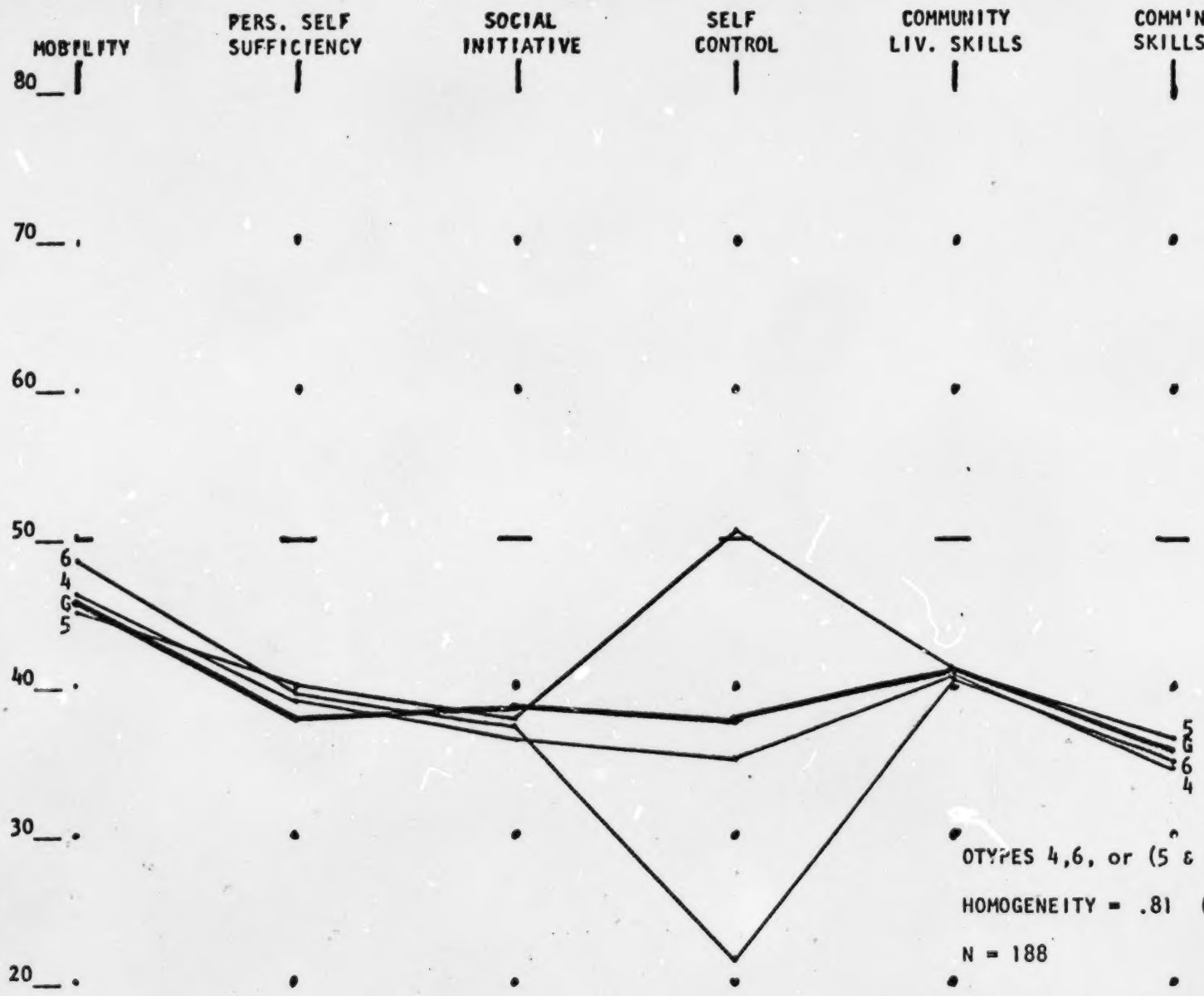
OTYPES 1 (& PRGS 3B,4,5) OR 2

HOMOGENEITY = .88 (.91)

N = 157

SLIDE 6

SENSORY-MOTOR DEVELOPMENT (G)



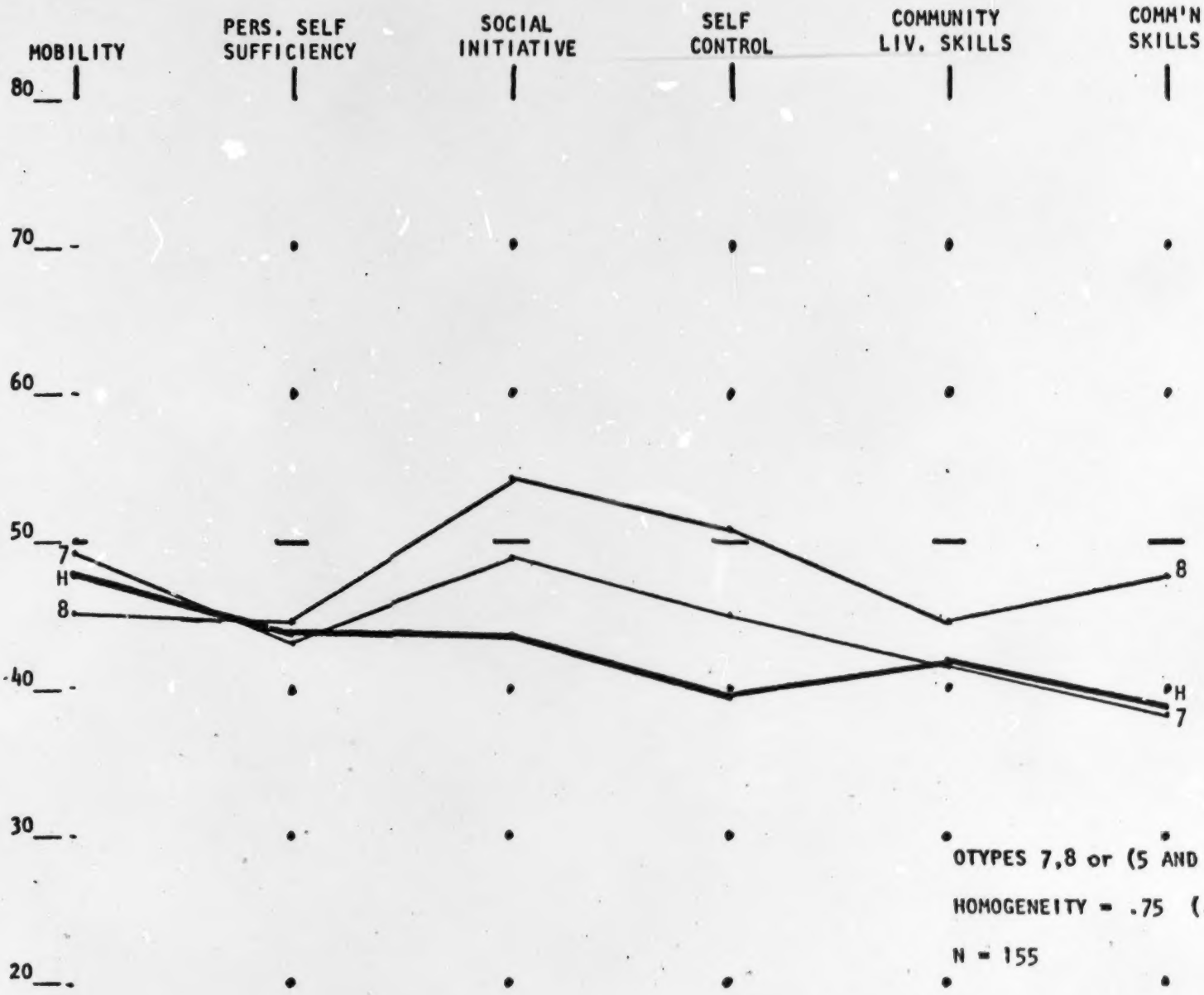
OTYPES 4,6, or (5 & PPS<45)

HOMOGENEITY = .81 (.90)

N = 188

SLIDE 7

SENSORY-MOTOR/SOCIAL DEVELOPMENT (H)



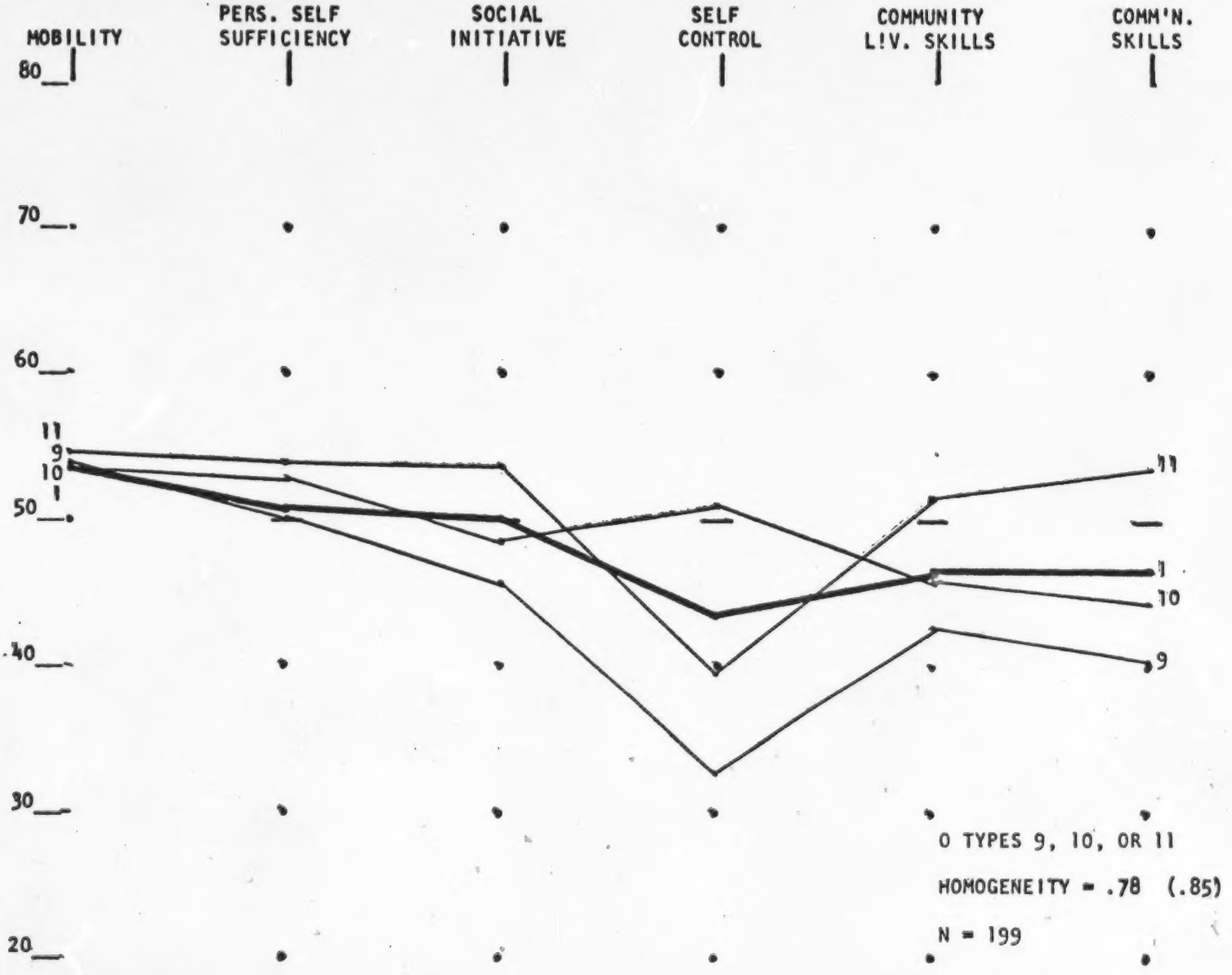
OTYPES 7,8 or (5 AND PSS>44)

HOMOGENEITY = .75 (.85)

N = 155

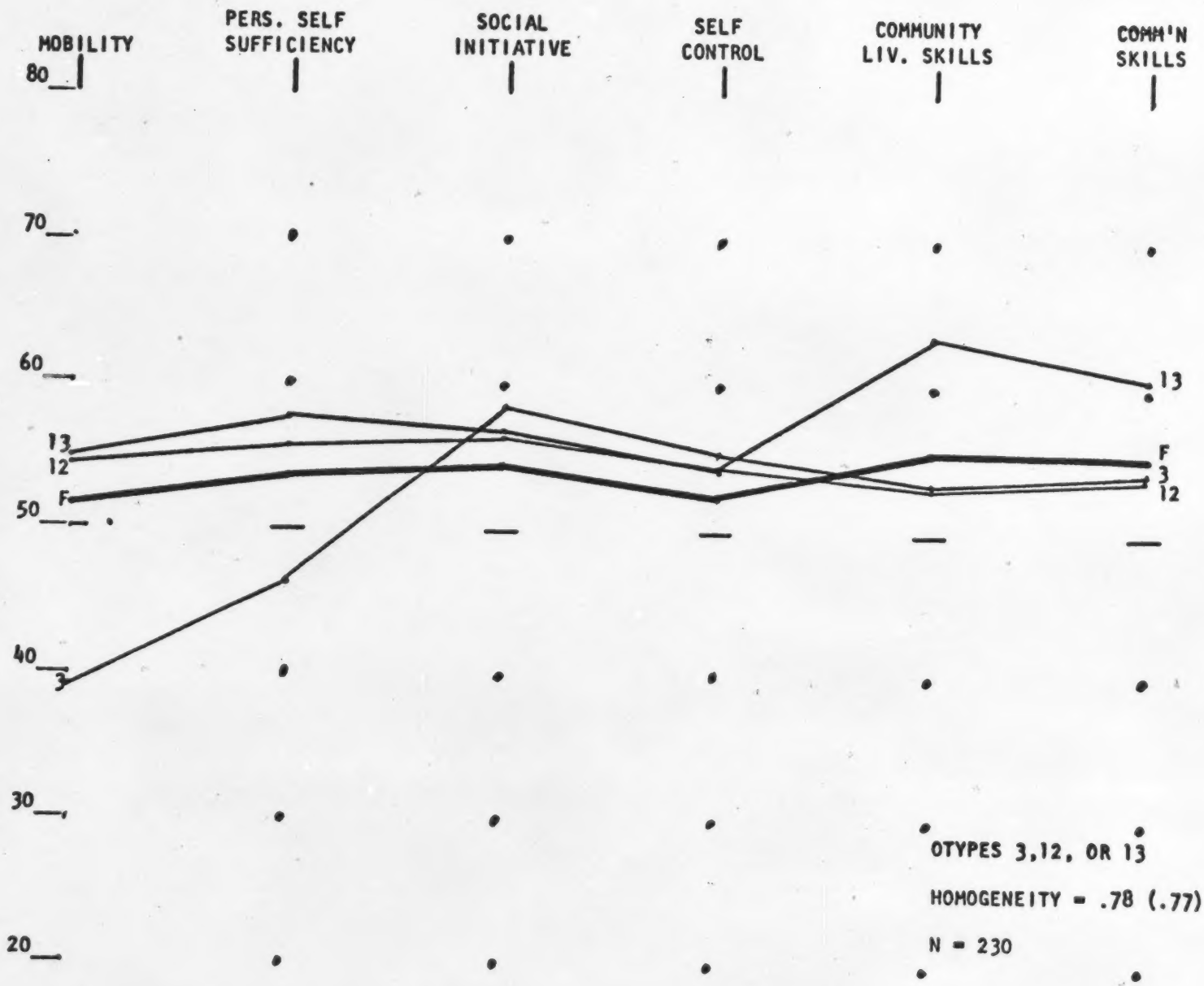
SLIDE 8

SOCIAL DEVELOPMENT (I)

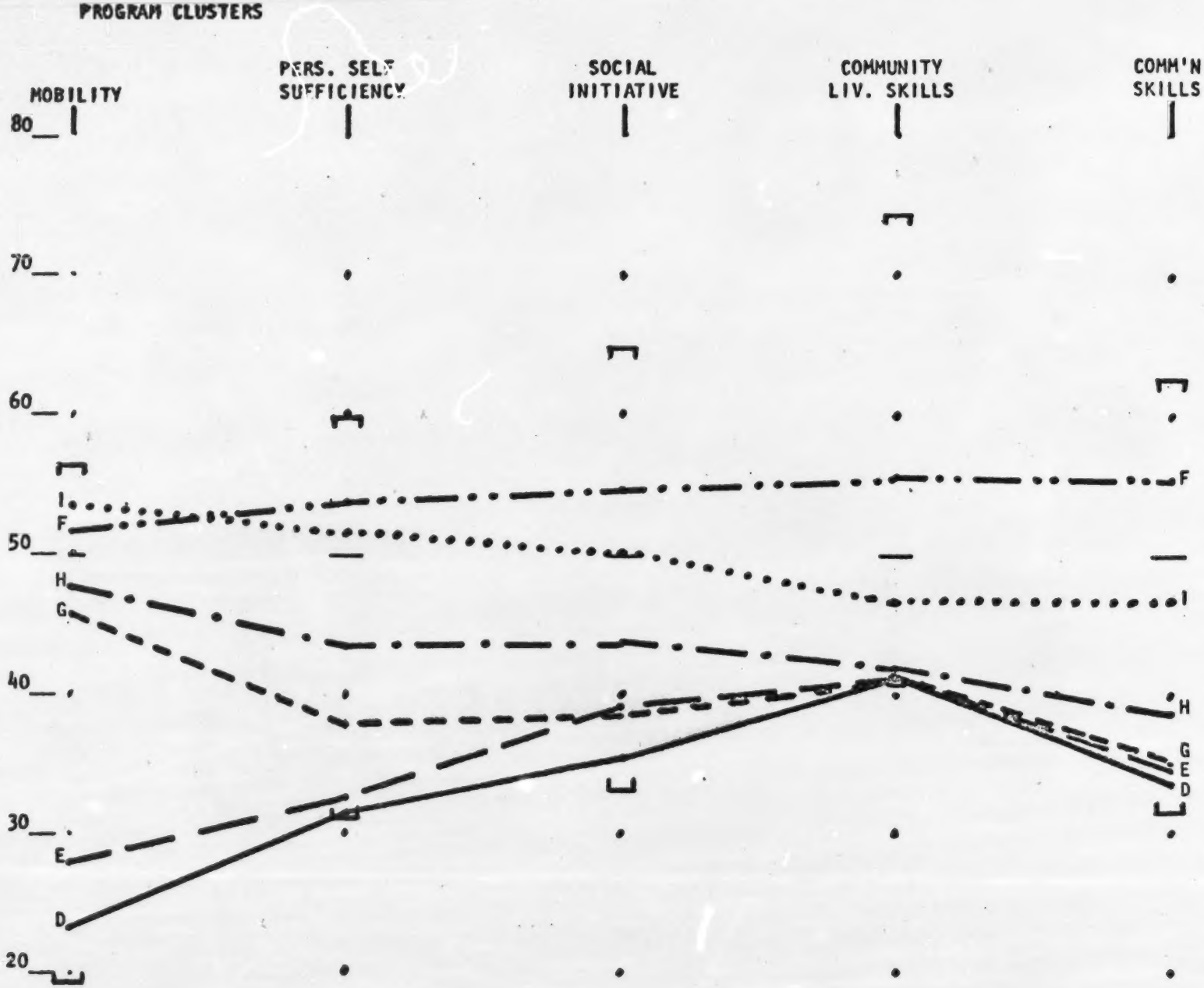


SLIDE 9

HABILITATION/TRANSITION (F)



SLIDE 10


PROGRAM CLUSTERS
MOBILITY
PERS. SELF SUFFICIENCY
SOCIAL INITIATIVE
COMMUNITY LIV. SKILLS
COMM'N SKILLS
80
70
60
50
40
30
20
I
F
H
G
E
D

SLIDE 11

SLIDE 12

AGREEMENT IN CLIENT DESIGNATION BETWEEN
STATISTICAL AND INTERDISCIPLINARY TEAM DETERMINATION

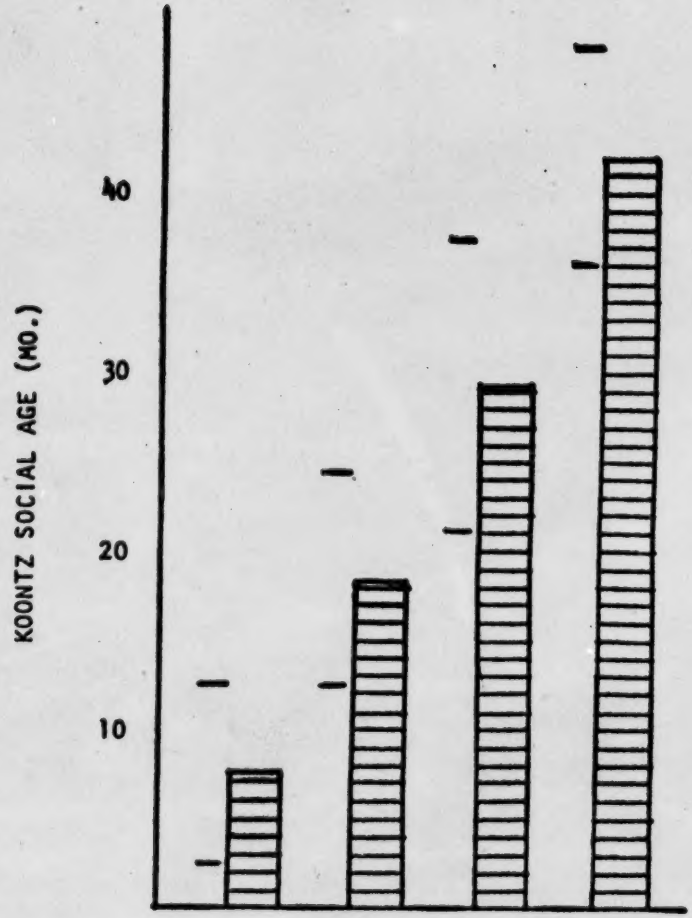
PROGRAM CLUSTER	% AGREEMENT	N
Medical/Physical	91	187
Physical Dev.	80	139
Sensory Motor	74	156
Sens. Motor/Social	62	86
Social Dev.	73	117
Habilitation	93	180
OVERALL	81	865

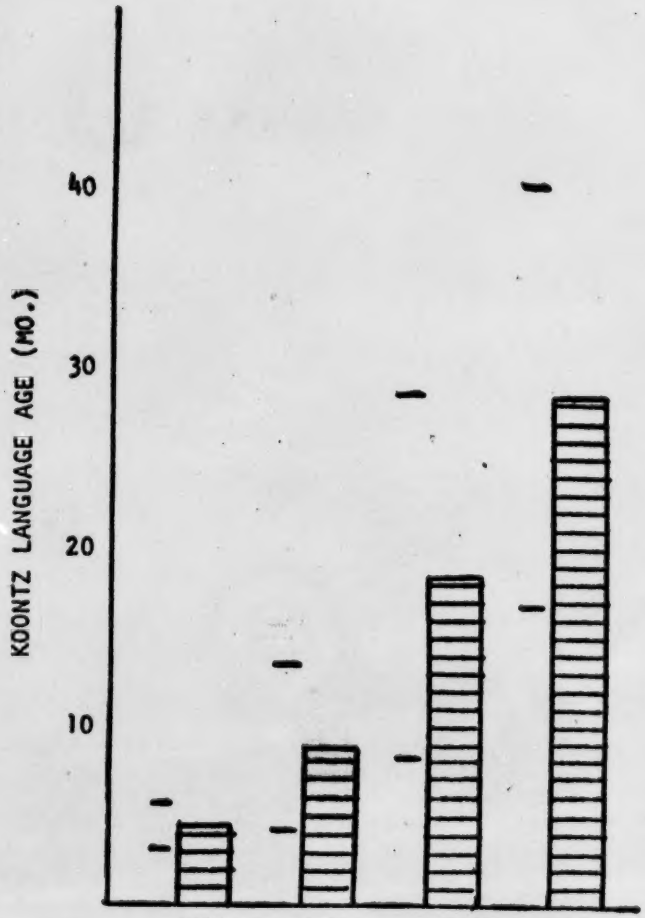
SLIDE 13

HOMOGENEITIES OF STATISTICALLY-DEFINED
AND ID TEAM-DEFINED PROGRAM CLUSTERS

	PROGRAM CLUSTER	HOMOGENEITY "COMPUTER"	HOMOGENEITY ID TEAM
D	Medical/Physical	.98	.95
E	Physical Dev.	.90	.91
G	Sensory-Motor	.79	.77
H	Sens. Motor/Social	.92	.90
I	Social Dev.	.86	.85
F	Habilitation	.88	.85
OVERALL		.87	.86

ANALYSIS OF KOONTZ CHILD DEVELOPMENTAL
SOCIAL AND LANGUAGE AGE
BY PROGRAM CLUSTERS





SLIDE 14

SLIDE 15

CRITERIA FOR NEW PROGRAMS

New programs should:

1. Be based empirically rather than on pre-conceived notions.
2. Be derived from data available on all residents.
3. Number approximately nine.
4. Each consist of a projected 100-200 residents.
5. Be partially derived from ID Team decision.
6. Not be defined with age or ambulation factors
7. Have more comparable residents than do current programs.

SLIDE 16

MANAGER OPINION SURVEY

Percentage of residents who:

1. Have been placed into groups similar in "important" characteristics:

E. Physical Development	92%	N = 6
I. Social Development	89%	N = 5
F. Habilitation/Transition	88%	N = 7

2. Will or have received improved care, training or experiences:

E Physical Development	95%	N = 6
I. Social Development	82%	N = 4
F. Habilitation/Transition	95% *	N = 7

* "Improved" or "equal"